Economic Lifecycle and Demographic Dividends: Evidence and Implications for India

1. Introduction

Individuals earn income and consumed goods and services during their productive period. In general, surplus income, or excess of income over consumption, is either saved or invested for future consumption or used to support consumption of their dependent children and elders members. In particular, consumption of individuals during economically unproductive period is supported by familial and transfers and asset reallocation, as they are determined by social values and norms or social contracts between household members. In a mixed economy like India, however, these transfers and assets are supplemented by the public sector through its redistributive and reallocation policies and programmes. Thus, economic lifecycle of individuals may be characterized by the age pattern of their income, and consumption of private and public goods and services.

Consequent upon the demographic transition, age structure of India's population has been undergoing remarkable changes in relative number of children, elderly and working age population. These changes have important implications for the economic lifecycle. For instance, during the first phase of demographic transition, the proportion of working age population provides a boost to the growth of per capita income and is referred to as "first demographic dividend" or "window of opportunity" (Bloom and Williamson, 1998; Mason, 1998; Bloom, Canning and Seville, 2002). The second phase of demographic transition experienced by developed nations and yet to begin in developing country including India, shall follow the first phase of demographic dividend. Last phase of demographic transition is characterized by population aging with shrinkage of working age population. As population become more concentrated at older working age, inertia to accumulate saving and asset to face the long face of retirement life gain momentum. This is referred to as "second demographic dividend" (Lee and Mason, 2006).

True "window of opportunity" or "demographic dividend" is widely known by now. Empirical studies, based of lifecycle model of saving, show that an economy with large share of working age population has potential to grow because the (a) demographic strategic structure generates a larger aggregate lifecycle surplus and (b) saving rates are expected to be higher as individuals save in anticipation of longer retirement life (United Nations, 2007). For instance, Williamson and Higgins (2001) relying on econometric modelling concluded that significant proportion of the rise in East Asian saving and investment rates since the late

1960s is due to the decline in youth dependency burden. Deaton and Paxson (1997) found that new generation of Taiwanese save more than their parents. Lee et al. (2001), based on the experience of Taiwan, employed support ratio (Cutler et al., 1990) to examine the relation between the demographic transition and saving and investment; and concluded that changes in the age structure are the partially accountable for the rise in saving and enhancement in life expectancy leads to higher saving rates. Mason (2006), based on simulation exercise of a number of countries, found that timing, duration and magnitude of demographic dividends varies across countries.

Lal (2006) argued that integration between population size and economic and technological changes can be decisive for social, political and economic consequences of population changes in India. Considering GDP growth rates in regression setting catalytic impact of age structure transition is found in south-east Asia but the theoretical framework of this study could not quantify demographic dividends. Chandrasekhar at al. (2006) provided supportive evidence for the need to enhance employability in terms of educational attainment and health in order to take advantage of the opportunity offered by India's age structure transitions. James (2008) described prerequisites for harvesting demographic dividends and found positive association between boom in the working age population in India and economic growth but did not provide estimates of demographic dividends citing methodological challenges and lack of adequate data. Ogawa et al.(2009) adopted NTA framework to associate Asia's changing demographic landscape with first and second demographic dividends. Demographic dividends have become talk of the researchers in India but till date there is no separate study on the estimation of first and second demographic dividends for India.

From the viewpoint of policy making, India's advantages of age structure transition have been highlighted in recent public documents. For instance, India's 11th Five Year Plan [Planning Commission (2008)] emphasises that India will have "a unique 25-year window of opportunity, called India's demographic dividend" (p.90). A sharp decline in expected dependency ratio is one of the main arguments for demographic dividend. However, no quantitative estimates of demographic dividends are available with policy makers and the stated period of window of opportunity is not supported by empirical evidence or otherwise. This paper is an attempt to fill in this policy research gap by quantifying the demographic dividends for India.

The next section introduces concepts and methods adopted for the present study followed by a section on data requirement and its sources. The third section is devoted to the discussion of findings of the study and the article ends with a section which provides concluding remarks.

2. Methodology

Economic support ratio (Cutler et al., 1990) defined as the effective number of producers per equivalent consumer is a redefined measure of dependency as it explicitly incorporates age-variation in consumption and labour productivity. Economic support ratio (L/N) is depicted as

$$L(t)/ N(t)= \sum_{a=0}^{w} \gamma(a)\, P\,(a,t) / \sum_{a=0}^{w} \phi(a)\, P\,(a,t) \quad (1)$$

Where, P(a, t) is the population aged a at time t, $\gamma(a)$ and $\phi(a)$ are age pattern of productivity and consumption respectively.

Denoting income, consumer and working population of a country by Y, N and L respectively, income per consumer can be decomposed as

$$Y/N= (Y/L)\ (L/N) \quad (2)$$

That is, income per consumer is the product of income per working age population and economic support ratio. This implies in growth terms

$$gr(Y/N)=gr(Y/L) + gr(L/N) \quad (3)$$

Where, gr stands for growth rate.

This economic growth depends on the growth of productivity and growth of the economic support ratio. Age structure transition results in large swings in the economic support ratio. First demographic dividend is conveniently and meaningfully quantified in terms of economic support ratio. Methodologies in general for age allocations of labour income and consumption by sectors consistent with National Income and Product Account (NIPA) in Mason et al. (2006) and for India in particular in Ladusingh and Narayana (2011).

Willis (1988) established the relationship between the per capita demand for wealth W and the age profiles of consumption $\gamma(a)$ and labour income $\phi(a)$ as

$$W= c(A_c - A_{yl}) \quad (4)$$

Where A_c and A_{yl} are the average age of consumption and labour income respectively, while c is the per capita consumption.

Classical lifecycle model ignored altruistic linkage between generations. National Transfer Accounts (NTA) framework outline in Mason et al. (2009) recognized the importance of public and familial intergenerational transfer. Under the NTA framework wealth W is

considered in broader perspectives than in Willis (1988) and per capita wealth is defined as the sum of per capital K and per capita wealth transfer (T) as

$$W= K+T \quad (5)$$

Transfer value is the present value of expected net transfers from all sources from the current population. It determines the effect of population growth on lifecycle consumption and important in view of the evidence of public and familial intergenerational transfer. Lifecycle wealth for adults is the difference between the present value of consumption and present value of labour income, that is

$$W = PV(C) – PV(Y) \quad (6)$$

W support future net costs of children through the intergenerational transfer (T_k) and future retirement in the form of pension wealth (T_p) defined as

$$W_p = W-T_k \quad (7)$$

The second demographic dividend, measured in growth terms, is the difference between the rate of growth of the consumption index and the rate of growth of the economic support ratio. In the later stage of growth age structure transition, with declining number of children, transfer to children relative to labour income (T_k/Yl) decreases while the pension wealth relative to labour income (T_p/Yl) increases.

Description of present scenario of economic support ratio and macroeconomic parameters related to wealth and transfer cannot unfold what will happen to the macroeconomic consequences of age structure transition. As a result demographic dividend can only be assessed and quantified through simulation exercise. We have adopted simulation model described in detail in Lee et al. (2000).

The analysis in the present paper adopts NTA framework of Mason et al. (2009), and Mason and Lee (2007).

3. Data sources

Age patterns of consumption of public and private goods and services, and labour income consistent with National Income and Public Accounts (NIPA) are require for quantification of demographic dividends. Macro aggregate controls for consumption for health, education and others from public (government) and private (household) for the financial year 2004-05 are extracted from the National Accounts Statistics (Central Statistical Organisation, 2006). From the same source macro aggregate for compensation of employees in terms of salary and wages and mixed income (that is, the value added in household enterprise) are taken for

estimation for labour income consistent with NIPA. The figures of these macro aggregate controls for the financial 2004-05 for India are shown in Table 1.

[Insert table 1 about here]

Micro unit level data on labour income and consumption for health, education and others (food, non-food, housing infrastructure etc.) in public and private (household) sectors are required for charting age patterns of labour income and consumption by sectors in Indian economy. The India Human Development Survey (Desai et al., 2008) conducted during 2004-05 is the source of micro data on labour income from wage and salary and from self employment, household expenditures on education, health care, food, non-food, house rent, money borrowed, household credit, enrolment status of children by public-private ownership of educational establishments, treatment status of individuals for minor and major morbidities. IHDS is a nationally representative survey covering 200 thousands individuals from over 41 thousands household spread over 1503 villages and 971 urban neighbourhoods and a multi-stage stratified sampling design has been adopted for the survey. The IDHS was jointly implemented by the University of Maryland, USA and the National Council for Applied Economic Research (NCAER), India with financial grant from the National Institute of Health (NIH), USA.

Medium variant projection of United Nations (2006) for India is the source for age structure transition the basis for linkage simulation exercise to quantify demographic dividends. The UN projection assumed decline in TFR to 1.85, IMR to 23 and improvement of life expectancy to 77.9 by 2050.

The basic data input for the simulation exercise are age patterns of per capita consumption and labour income. Additionally for the simulation presented in this paper assumes that share of familial intergenerational transfer and public transfer wealth to support population in 60 plus is constant during the simulation period, risk free discount of return of 3%, rate of depreciation of 3% and rate of return of 6% on assets declining linearly to a steady state interest of 4.42 % in 2300. These assumptions are broadly on line with the NTA project member countries results on intergenerational transfer (Ladusingh and Narayana, 2009) and macro-economic parameters of countries which had experience demographic dividends in the course of demographic transition.

4. Economic lifecycle

Age pattern of per capita consumption is the pooled per capita consumptions on education, health and others, computed separately for public and private contributions. In the present article only the pooled age pattern of per capita consumption shall be highlighted and sector

wise public and private per capita age pattern of consumption are in Ladusingh and Narayana (2011). Age pattern of labour income is estimated incorporating consumption to employees in the form of salary and wages, and two third of mixed-income of entrepreneurs. Estimation of age profile of per capita by sectors and labour income are based on micro data from IHDS and sealed to make it consistent with macro-aggregate controls shown in table 1 and population weighted to capture the age-structure of Indian population.

Summarization of age patterns of consumption by sectors in terms of mean age of consumption by sector and share of public and private contribution in the total consumption are provided in table 2.

[Insert table 2 about here]

It can be noted that mean age of consumption both public and private sectors taken together stands at 49 years, while respective mean ages of consumption for these two sectors in the aforesaid order are 43.5 and 50.1 years respectively. The mean ages for consumption for health care in public and private sectors are 58.3 and 58.4 years. The high mean age of consumption for health care in private sector (household) is the indicative of the fact that individuals incurred out-of-pocket expenditure for health care with advancing age. As for education mean ages of public and private consumptions are 13.3 and 14.2 years. Other public consumption is for infrastructure defence etc. and the mean age of consumption is 45 years. Private consumption others includes food, clothing social expenditure etc. and the corresponding mean age is 59.7 years. It is important to note that consumption is dominated by private sector as it account for 80.4 percent of the total consumption of health, education and others. Decimal proportion either by household or public sector are devoted to health and education, a typical characteristics of developing countries.[This sentence is not clear]

The discussion in the forgoing paragraph reveals that in an economy the public and private sectors contrast each other in terms of emphases on basket of goods and services consumed over the lifecycle. Figure 1 shows the graphical depiction of economic lifecycle in case of India. The age profile of per capita labour income reflects a number of distinctive features.

Labour earnings are zero for children starts in early teens, gradually increases with age, show a steep increase around the age of 20 years and attained its peak in mid-fifties, thereafter declines rapidly and tappers towards the end with advancing age. Existence of child labour is apparent in the early age of entry into the work force and marginal share of labour income by young persons. In organised sector, wages and salary enhancement of employees is on seniority basis.

[Insert figure 1 about here]

In traditional society like India, assets and property are mostly owned by head of the household, especially in the traditional jointly family system. These institutional features are reflected in the late peak of lifecycle income profile. Elders in India continue to work in low paid unorganised sector or work in the own farm. This is evident in the tapering income profile at advanced age. Age profile of per capita consumption also exhibits interesting, features, particularly, during the school going age and at older ages. Consumption levels are low for children and rise almost linearly throughout childhood attains early peak at about 19 years showing huge investment for education and continue to increase up to 25 years, the age of completion of education. Consumption slowly rises over the adult years reaching a peak at 60 years. The consumption profile crosses the income profile at 25 and 60 years of age, which mark the average age into labour force and retirement respectively. During the 35 years of economically gainful activities, per capita consumption profile is more or less stable with marginal rise in the level of post retirement age due to health care cost.

5. Demographic dividends

During the demographic transition fertility decline has resulted in fewer children to be fed and increase in the life expectancy in the initial stage leads to rapid growth of working age population. In this period per capita income grows faster than before and the underlying population experience first demographic dividend and is referred to as the phase of window of opportunity. As the first demographic dividend has to do more with the rapid growth of per capita labour income, economic support ratio defined as the effective producer per equivalent consumer expressed in terms of age patterns of per capita labour income and consumption in equation (1) can capture first demographic dividend more effectively. Commonly used age dependency ratio is only proxy measure of economic lifecycle and it is not suitable to quantify first demographic dividend. Figure 2 shows the simulated trend in economic support ratio for India based on economic lifecycle shown in figure 1 as input.

[Insert figure 2 about here]

The economic support ratio started to increase from 1975 and gained momentum in the 2000s coinciding with the age structure transition having increasing share of working age population and declining number of children. The numerical value of effective producer per equivalent consumer crosses the critical value of 1 after 2025 and remains above the critical value till 2045. The period 1975-2045 having a span of 70 years during which the economic support ratio keep increasing is the period of first demographic dividend for India.

The first demographic dividend period is transitory in nature for fact that with further decline in fertility and improvement in life expectancy enter the phase of rapid population aging and

shrinking of working age population. At this stage the economic support ratio begin to decline and the phase of second demographic dividend starts with some overlapping period with the phase of first demographic dividend. The second demographic dividend is characterised by accumulation of asset to support extended period of retirement with population aging.

The second demographic dividend, measured in growth terms, is the difference between the rate of growth of the consumption index ($\bar{c}/\bar{yl}$) and the rate of growth of support ratio (Lee and Mason, 2007). Figure 3, shows the trends in the rate of growths of consumption index, support ratio and second demographic dividend obtained by simulation.

[Insert figure 3 about here]

The important features of second demographic dividend, which is measured as the difference between consumption index ($\bar{c}/\bar{yl}$) and support ratio (L/N) is that the annual growth before dividend period (before 1975) is largely negative and is not stable as it shows drastic swings. However, it is during the period of first demographic dividend, 1975-2045 the annual growth rate of second demographic dividend starts rising with time lag. Secondly, the peak in the growth rate of second dividend is attained when the growth rate of first dividend become negative for the reasons highlighted in the forgoing discussion.

An important macro-economic consequence of age structure transition and emergence of demographic dividends is the manner in which component of wealth accumulation changes over time during the pre and post-dividend period. Child transfer wealth (T_k/Yl(-)), pension wealth (Wp/Yl), assets (A/Yl) and consumption (C/Yl) depicted in figure 4 are in terms of the present values of the future child bearing cost, pension wealth, assets and consumption respectively.

[Insert figure 4 about here]

Prior to 1975, the beginning year of first dividend child bearing cost relative to labour income is high and during the first dividend period 1975-45 it decline and stabilize from 6 times to about 3 times the labour income. The declines in child bearing cost during the dividend period is first due to falling fertility and second the shift in age structure with larger proportion of 60 plus population who had cross prime child bearing stage. The pension wealth and assets rise substantially over the dividend period. In 1975 both pension wealth and assets were quite low and pension wealth nearly reach 5 times the labour income in 2045 and continues to rise steadily, while the assets have reached nearly 3 times the labour income compared to the current value of nearly 1.2. The simulation study has shown that there is

tremendous accumulation of wealth during the phase of demographic dividend. These results agree with theoretical notion that with falling fertility transfer to children towards cost of bringing up declines and with increasing life expectancy people started saving more to support longer retirement life.

6. Size of demographic dividends

Quantification of size of first and second demographic dividend depends on the consideration of time period of dividend. The convention is to consider the period during which the economic support ratio consistently increase and it is 1975-2045 in the case of India. Table 3 shows the percent annual gain for first and second demographic dividend during the period of window of opportunity for India.

[Insert table 3 about here]

On the whole, during dividend period, income per equivalent consumer increases by 42.2 percent, which is the estimated total demographic dividend. As the second demographic dividend starts gaining momentum at the time when the first demographic dividend starts phasing out due to its transitory nature, the contribution of second dividend is expected to dominate, particularly after 2045. This is evident by percent growth rates of first and second demographic dividends for the period 1975-2070 and 1975-2100 as shown in the lower panel of table 3. During 1975-2070, total demographic dividend for India increases by 41.8 percent for which the contribution of first and second demographic dividends are 19.4 and 22.4 percent respectively. This offered evidence for the prominence and durability of second dividend over the first dividend in the long run. Similar exercise considering longer period 1975-2100 indicate the stability of second dividend but not of first dividend, because the phase of first dividend dwindles out after 2045. These results of the period of demographic dividends and sizes of these dividends for India closely correspond to that of Asia in United Nations (2007).

7. Conclusions

Based on the NTA framework, this paper estimates and offer evidence for positive macro-economic implication of age structure transition in India. The implications are quantified by first and second demographic dividends. The estimates are based on economic support ratios and accumulation of wealth relative to labour income. Economic support ratio translates economic lifecycle as a measure of first demographic dividend in terms of effective member of procedures per consumer. Age patterns of per capita labour income of consumption of public and private goods and services convey individual preference, choice and behavioural aspect including intergenerational transfer, public policy and market orientation. Economic

support ratio replace ad-hoc age dependency ratio as a refined measure of first demographic dividend. As the estimation process of per capita of age patterns labour income and consumption are population weighted and constrained by macro aggregate controls, economic lifecycle genuinely captures the economy of a country in a broader perspective. The second demographic dividends rest of assumptions that individuals have altruistic bonds and half of children costs are met through familial transfers and the rest public transfers.

The main results of this paper are as follows. The estimated first demographic dividend is higher during the period 1975-2045. From 2045 onwards the first dividend dwindles out and second demographic dividend starts gaining prominence. The total dividend for India shall remain stable up to 2070, as the first dividend transfer to children relative to labour income gradually declines while the pension wealth and assets accumulation relative to income are steadily rising.

The linkage between the demographic dividends and income growth is policy dependent. The first dividend is in part the consequence of expanding work age population and can be realised only if employment opportunities are open up keeping pace with the increase of working age population. The second dividend arises largely because prime age adults have to save to support longer retirement as fewer children shall be available with fertility decline. For harvesting economic gains of emergence of demographic dividend, however, an environment conducive to accumulate assets is a prerequisite. Some of these prerequisites have started receiving policy attention in India, as they are reflected in policies and programmes (e.g. sill development) in India's 11the Five Year Plan. The results of this paper offer strong empirical justifications for strengthening public policies for employment, education, healthcare and social equity.

REFERENCES

Bloom, D.E., and Canning, D.1998. Demographic Transition and Economic Miracles in Emerging Asian. *World Economic Review*, 12(3), 419-456.

Bloom, D.E., Canning, D. And Savilla, J.,2002. The Dempgraphic Dividend: A New Perspective on Economic Consequences of Population Change. RAND, Santa Monica, CA.

Central Statistical Organisation. 2006. National Accounts Statistics. Government of India.

Chandrasekhar, C.P., J. Ghosh and A. Roychowdhury 2006. The Demographic Dividend and Young India's Economic Future. *Economic and Political Weekly*, 5055-5064.

Cutler, D.M., J.M. Poterba, L.M. Sheiner and L.H. Summers, 1990. An Aging Society: Opportunity or Chanllenge? Brookings Papers on Economic Activity, Vo. 1, pp. 1-73. Washington, DC: Brokings Institution.

Deaton, A. and C.H. Paxson, 1997. The Effect of Economic and Population Growth on National Saving and Inequality. *Demography*, 34(1), 97-114.

Desai, Sonalde, A. Dubey, B.L. Joshi, M. Sen, A. Sheriff and R. Vanneman. 2008. India Human Development Survey, University of Maryland College Park, MD, USA.

James, KS,2008. Glorifying Malthus: Current debate on 'Demographic Dividend' in India. *Economic and Political Weekly*, 63 -69.

Ladusingh, L. and Narayana, M.R. 2009. Population Aging and Life Cycle Deficit: The case of India in Singh, K.K., R.C. Yadava and A. Pandey (ed) Population, Poverty & Health. New Delhi: Hindustan Publishing House.

Ladusingh, L. and Narayana, M.R. 2011. The role of familial transfers in supporting life cycle deficit in India, in Lee and Mason (ed), *Population Aging and the Generational Economy: A Global Perspective*, Edward Elgar, UK: Cheltenham & International Development Research Centre, Canada: Ottawa.

Lal, D. 2006. India: Population Change and Its consequences. *Population and Development Review* , 32 (Supplementary), 145-182.

Lee, R. and Mason, A. 2007. Population Ageing, Wealth and Economic Growth: Demographic Dividends and Public Policy, WESS Background Paper.

Lee, R., and Mason, A. 2006. What Is the Demographic Dividend? Finance and Development. September, 2006,pp.16-17.

Mason, A. 1988. Saving, Economic Growth, and Demographic Change. *Population and Development Review*, 14(1), 113-144.

Mason, A. 2006. Population Ageing and Demographic Dividends: The Time to Act is Now. *Asia-Pacific Population Journal*, Vol.21, No.3, pp.7-16.

Mason, A., and Lee, R., 2007. Reforms and Support Systems for the Elderly in Developing Countries: Capturing the Second Demographic Dividend, *Genus*, Vol. LXIII, No.2, pp.11-35.

Mason, A., R. Lee, A.C.Tung, M.S. Lai and T.Miller 2009. Population and ageing and intergenerational transfers: Introducing age into national income accounts, in D. A. Wise (ed.), *Development in Economics of Aging*, National Bureau of Economic Research Conference Report, Chicago: University of Chicago Press, pp. 89-122.

Ogawa,N,Amonthep Chawla and Rikiya Matsukura 2009. Some New Insights into the Demographic Transition and Changing Age Structures in the ESCAP Region, *Asia-Pacific Journal of Population*, 24(1), 87-116.

Planning Commission. 2008. 11th Five Year Plan (2007-2012), Volume I: Inclusive Growth. (New Delhi): Oxford University Press.

United Nations 2007. World Population Monitoring,Focusing on the Changing Age Structures of Populations and their Implications for Development-Report of the Secretary-General, Commisiion on Population and Development, Economic and Social Council.

Willianson, J.G. and M. Higgins 2001. The Accumulation and Demography Connection in East Asia. Population Change and Economic Development in East Asia: Challenges Met, Opportunities Seized. A. Mason. Stanford, Stanford University Press: 123-54.
Willis, R.J. 1998.Life Cycles, Institutions and Population Growth: A Theory of the Equilibrium Interest Rate in an Overlapping Generational Model, in Lee,R., Arthur, W.G. and Rodgers, G. (ed.) Economics of Changing Age Distribution in Developed Countries New York, USA: pp.106-138. Oxford University Press.

Table 1: Macro aggregate control for labour income and consumption by sectors in India, 2004-05

Consumption by sector	Public	Private	Total
Education	58795	34507	93302
Health	22805	94156	116961
Others	260942	1279281	1540223
Macro-Control for labour income			1584535

Source: National Accounts Statistics, 2006. Note: Figures are in crores, one crore = 10 million INR

Table 2: Summary of the estimated share of public and private consumption and mean age of consumption in India, 2004-05

Consumption by Sector	Share (%)	Mean age of consumption
Total consumption	100	49.0
Public consumption	19.6	43.5
Health	1.3	58.3
Education	3.4	13.3
Others	14.9	45.0
Private consumption	80.4	50.1
Health	5.4	58.4
Education	2.0	14.2
Others	73.0	59.7

Table 3: Gains in Income per Equivalent Consumer during the Dividend Period

Period	Annual Gains (percent)			Total Gains (percent)
	First Dividend	Second Dividend	Total	
1975-2045	0.42	0.18	0.60	42.2
		Total Gains (percent)		
1975-2070	19.4	22.4	41.8	-
1975-2100	14.1	22.3	36.4	-

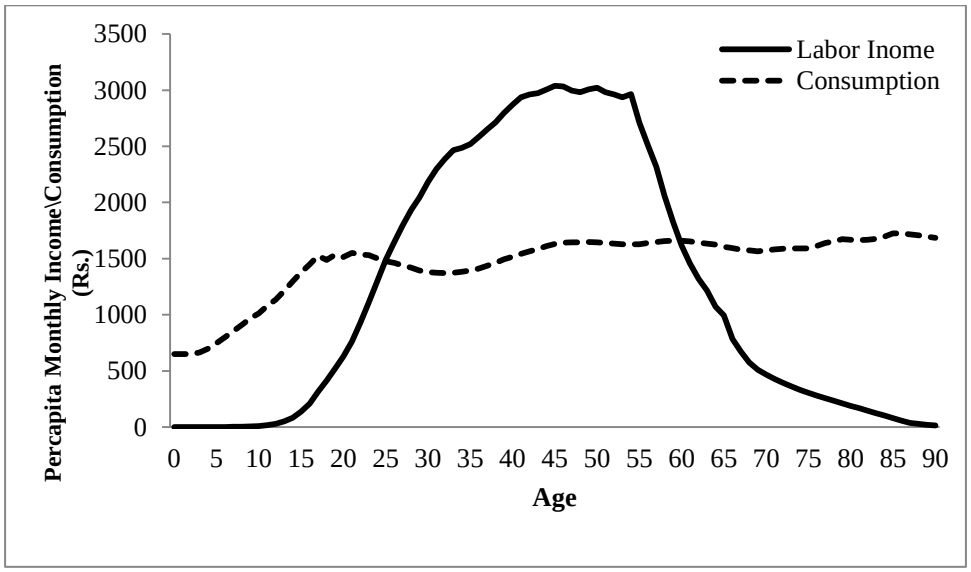

Figure 1: Economic lifecycle for India, 2004-05

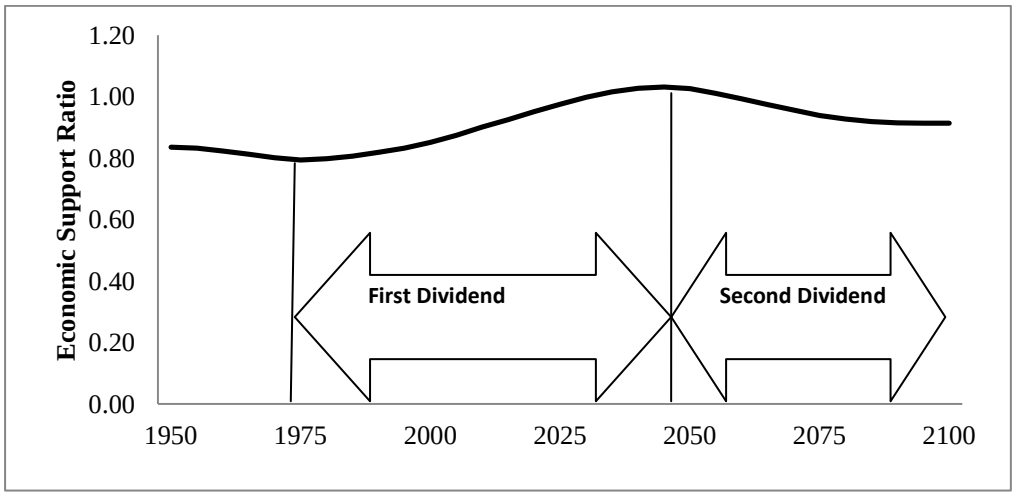

Figure 2: Period of Demographic Dividends, India

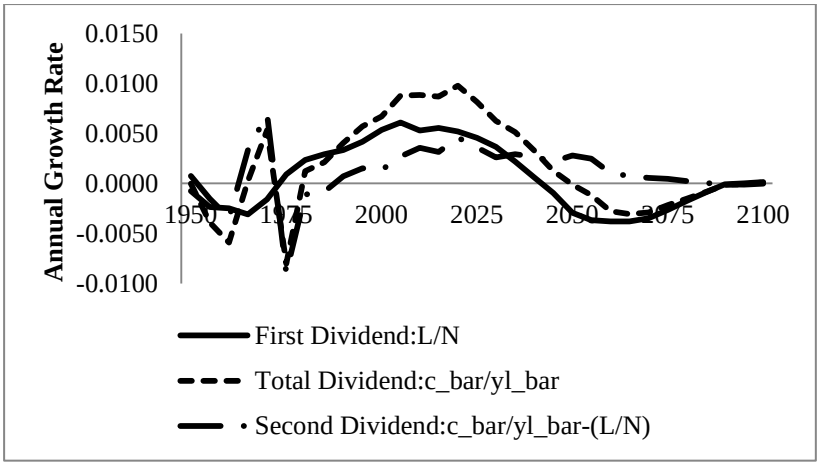

Figure 3: Annual Growth rates of Demographic Dividends, India

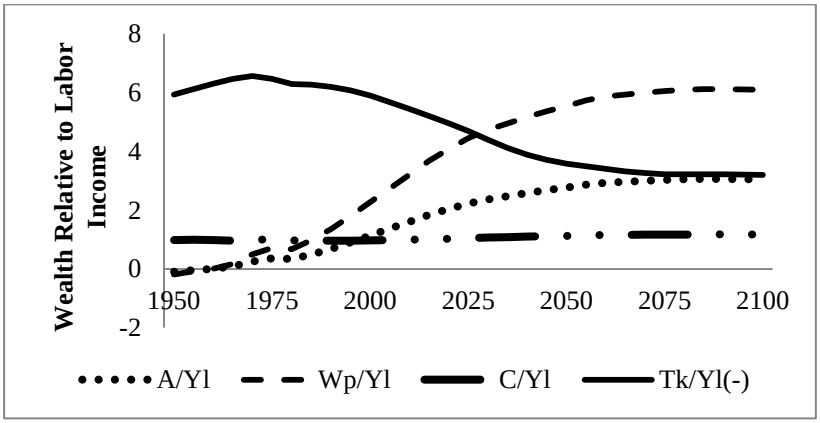

Figure 4: Components of Wealth Accumulation, India